Unconventional monetary policy and the dollar-euro exchange rate: First results from time-series analysis

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Abstract

This paper examines the impact on the US dollar-Euro (USD-EUR) exchange rate of the unconventional monetary policy conducted by the US Federal Reserve (Fed) and the European Central Bank (ECB). To that end, we make use of time series analysis to obtain a reasonable long-run and short run representation of the data generation process and use dummy variables to study how announcements about monetary policy changes can affect the USD-EUR exchange rate. Our results indicate that the announcement and subsequent implementation of such measures by the ECB would have caused an appreciation of the dollar, while those by the Fed would have caused a depreciation of the dollar.

JEL classification numbers: C32, E52, E58, F31, G15.

KEY WORDS: Quantitative easing, Unconventional monetary policy, Announcements, Federal Reserve Bank, European Central Bank. Exchange rates.

I. Introduction

There is a large body of literature investigating the effects of unconventional monetary policy tools on macroeconomic variables and financial markets as a response to the 2007–2009 global financial crisis (see, e.g., Joyce et al., 2012; Moessner, 2015; and Lutz, 2015).

The purpose of this paper is to contribute to the literature by examining the effects of quantitative easing and other unconventional monetary policies announcements on exchange rates by analysing on the impact of QE announcements by the US Federal Reserve (Fed) and the European Central Bank (ECB) on the on the US dollar-Euro (USD-EUR) exchange rate.

The paper is organised as follows. Section II presents the econometric methodology, while Section III describes the data set and reports the empirical results. The paper ends with some concluding remarks.

II. Econometric methodology

To evaluate the effect of the monetary measures on the USD-EUR exchange rate, we estimate econometric models that provide a reasonable representation of the evolution of such series on a daily basis.

Since there is some consensus in the theoretical and empirical literature on exchange rate determination in pointing to the interest rate differential as an influential key variable in its evolution (see, eg, Taylor, 1995), we initially start from the following theoretical long-term relationship:

$$s_t = \lambda_0 + \lambda_1 (c_t - c_t^*) + \xi_t \qquad (1)$$

where s is the logarithm of the exchange rate (expressed as the home currency Price of a unit of foreign exchange)[1] and $(c - c^*)$ is the 3-month interest rate differential.

[1] Note that an increase in the exchange rate implies a depreciation of the national currency (the US dollar) and an appreciation of foreign currency (the Euro).

Secondly, given the special role of the sovereign bond markets in the recent financial crisis (see, for example, Beirne and Fratzscher, 2013), we also analyze the relationship between the (log of) exchange rate and the long-term interest rate differential.

$$s_t = \lambda_0 + \lambda_1 (l_t - l_t^*) + \xi_t \qquad (2)$$

where $(l - l^*)$ denotes the difference between the domestic and foreign ten-year yield.

Finally, given the extensive empirical evidence documenting the possible effect on the foreign exchange markets of speculative movements in the stock markets (see, for example, Kanas, 2000), we study the following relationship:

$$s_t = \lambda_0 + \lambda_1 (b_t - b_t^*) + \lambda_2 v + \xi_t \qquad (3)$$

where $(b - b^*)$ is the difference between the (log of) the domestic and foreign stock market indeces and v represents a measure of the overall market sentiment.

For these three long-run relationships we test for cointegration and for an error correction model (ECM) representation (Engle y Granger, 1989):

$$\Delta s_t = \alpha_0 + \beta ect_{t-1} + \sum_{i=1}^{m} \delta_i \Delta s_{t-i} + \sum_{j=1}^{n} \gamma_j \Delta (a_{t-j} - a_{t-j}^*) + \varepsilon_t \qquad (4)$$

where Δ denotes the time difference, $(a - a^*)$ is the considered differential and ect_{t-1} is the error correction term incorporating the residuals from the cointegrating regression. If s and $(a - a^*)$ are not cointegrated, we impose β=0 in (4).

Following the common practice in the empirical literature in this area, we expand the ECM by adding dummy variables to pick up the measures announced by the ECB (*DBCE*) and the Fed (*DFED*):

$$\Delta s_t = \alpha_0 + \beta ect_{t-1} + \sum_{i=1}^{m} \delta_i \Delta s_{t-i} + \sum_{j=1}^{n} \gamma_j \Delta (a_{t-j} - a_{t-j}^*) + \phi DBCE_t + \varphi DFED_t + \varepsilon_t \qquad (5)$$

DBCE takes the value 1 for dates on which the ECB has announced its purchases of assets and zero otherwise (Table 1), while *DFED* takes the value 1 for dates when the Fed announced purchases of assets and zero otherwise.

[Table 1 here]

III. Data and empirical results

We use daily data for the period from January 2, 2007 to January 31, 2015. Exchange rate data came from the ECB Statistical Data Warehouse. Regarding interest rates, the 3-month rates (taken as representative of the short term) were obtained from the financial web Invertia. Yields on 10-year government bonds (taken as proxies of long-run interest rates) are from the US Treasury Department, using the German bond as a representative of EMU. As for the stock indexes, we used data from Datastream: the S&P500 index for the USA and EUROSTOXX 50 for EMU. Finally, we use VIX volatility index developed by the Chicago Board Options Exchange to approximate the market sentiment.

As a first step, we tested for the order of integration of the series by means of the Augmented Dickey-Fuller (ADF) tests. The results, not shown here but available from the authors, decisively reject the null hypothesis of non stationarity, suggesting that both variables can be treated as first-difference stationary[2].

As a second step, we tested for cointegration using Johansen's (1991) approach. As can be seen in Table 2, only in the case of the relationship between exchange rates and long-run interest rate differential we reject the existence of a cointegrating equation at least 5%. Thus, we estimate dynamic models in first differences with an error correction term in equation (4) for relations (1) and (3), while for the relationship (2) do not add that term [ie, we impose β = 0 in (4)].

[Table 2 here]

The estimated cointegrating equations for equations (1) and (3) are as follows (standard error in parentheses):

$$s = 0.2933 + 0.0397\,(c_t - c_t^*)$$

(0.0043) (0.0051)

R^2=0.84, Engle-Granger tau-statistic=-4.4973, Engle-Granger z-statistic=-31.2208

$$s = 0.2533 - 0.1374\,(b_t - b_t^*) - 0.080\,v_t$$

[2] These results were confirmed using the Kwiatkowski et al. (1992) tests, where the null is a stationary process against the alternative of a unit root.

(0.0125) (0.0078) (0.0046)

R^2=0.89, Engle-Granger tau-statistic=-4.7344, Engle-Granger z-statistic=-32.1032

As can be seen, our results suggest that an increase in the nominal short-term interest in the USA relative to EMU, reflecting expectations of higher inflation would reduce demand for real balances, raise prices and depreciate the USD-EUR exchange rate. Also, an increase in the US stock index with respect to the EMU one would raise the demand for US securities, which appreciate the USD-EUR exchange rate. Finally, our results indicate that an increase in financial instability (higher VIX) would lead to a "flight to quality" which would result in a higher relative demand for dollars, thus leading to an appreciation in the USD-EUR exchange rate.

Tables 3 to 5 report the estimation results for the different specifications of equation (5). As shown in the table, the dummy variables associated with the announcement of unconventional policies are significant at the usual levels and the signs indicate that the announcement and subsequent implementation of such measures by the ECB would have caused an appreciation of the dollar (with the consequent depreciation of the euro), while those announcements by the Fed would have caused a depreciation of the dollar (appreciation of the euro). Additionally, our estimates suggest that an increase in the short-run and long-run interest rate differential between USA and EMU would lead to a depreciation of the USD-EUR exchange rate, supporting the predictions of monetary models of exchange-rate determination. Regarding the differential in stock indices and the role of financial instability, the results suggest that the dollar appreciates against the euro when the US yield exceeds European ones and when uncertainty increases in the markets. Finally, note that the error correction terms are significant and negative, supporting once again the existence of previously identified cointegrating relations.

[Tables 3 to 5 here]

IV. Concluding remarks

We investigate whether the quantitative easing and other unconventional monetary policies announcements by the ECB and the Fed affect the USD-EUR exchange rate, using daily data for a period from January 2, 2007 to January 31, 2015.

Our results indicate that the announcement of such measures by the ECB would have caused an appreciation of the dollar, while those by the Fed would have caused a depreciation of the dollar.

From an international perspective, these findings imply that central banks should coordinate their unconventional policies to avoid contradictory or overly stimulative effects.

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Table 1: Event announcements

Date	Country	Event	Action
28/03/2008	ECB	LTRO	Governing Counsil Press Release
15/10/2008	ECB	FRFA	Governing Counsil Press Release
25/11/2008	Fed	QE1	FOMC Statement
01/12/2008	Fed	QE1	Bernanke Speech
16/12/2008	Fed	QE1	FOMC Statement
28/01/2009	Fed	QE1	FOMC Statement
18/03/2009	Fed	QE1	FOMC Statement
07/05/2009	ECB	CBPP/LTRO	Governing Counsil Press Release
12/08/2009	Fed	QE1	FOMC Statement
23/09/2009	Fed	QE1	FOMC Statement
04/11/2009	Fed	QE1	FOMC Statement
10/05/2010	ECB	SMP	Governing Counsil Press Release
30/06/2010	ECB	CBPP/LTRO	Governing Counsil Press Release
10/08/2010	Fed	QE1	FOMC Statement
27/08/2010	Fed	QE2	Bernanke Speech
21/09/2010	Fed	QE2	FOMC Statement
12/10/2010	Fed	QE2	FOMC minutes released
15/10/2010	Fed	QE2	Bernanke Speech
03/11/2010	Fed	QE2	FOMC Statement
22/06/2011	Fed	QE2	FOMC Statement
21/09/2011	Fed	Maturity Extension Program	FOMC Statement
06/10/2011	ECB	CBPP2	Governing Counsil Press Release
08/12/2011	ECB	LTRO	Governing Counsil Press Release
20/06/2012	Fed	Maturity Extension Program	FOMC Statement
02/08/2012	ECB	OMT	ECB Press Conference
22/08/2012	Fed	QE3	FOMC minutes released
31/08/2012	Fed	QE3	Bernanke Speech
06/09/2012	ECB	OMT	Governing Counsil Press Release
13/09/2012	Fed	QE3	FOMC Statement
12/12/2012	Fed	QE3	FOMC Statement
22/01/2015	BCE	Expanded asset purchase programme	ECB Press Conference

Source: Websites of the European Central Bank (ECB) and the Board of Governors of the Federal Reserve System (Fed)

Notes: CBPP=Covered bond purchase programme

FRFA= fix-rate, full-allotment operation

LTRO= Long-term Refinancing Operation

OMT=Outright Monetary Transactions

QE=Quantitative easing

Table 2: Cointegration tests

	Hypothesized numbers of cointegrating relations	Trace statistic[a]	p-value[b]
s, (c-c*)	None At most one	18.3903** 2.9483	0.0178 0.0867
s, (l-l*)	None At most one	11.6837 2.0424	0.1727 0.0153
s, (b-b*), v	None At most one At most two	31.7903** 14.8165 5.3576**	0.0291 0.0631 0.0206

Notes:

a. ** Rejection of the hypothesis at 5% level.
b. MacKinnon *et al.* (1999)'s p-values.

Table 3: ECM with short-run interest rates

Variable	Coefficient	Std. Error	t-Statistic
ect_{t-1}	-0.2381	0.0482	-4.9446
$\Delta(c_t - c_t^*)$	0.4921	0.1654	2.9757
$\Delta(c_{t-1} - c_{t-1}^*)$	0.5617	0.2040	2.7536
DECB	-0.0066	0.0023	-2.8098
DFED	0.0088	0.0026	3.3393
R^2	0.8929		
Adjusted R^2	0.8541		

Table 4: ECM with long-run interest rates

Variable	Coefficient	Std. Error	t-Statistic
DECB	-0.0060	0.0021	-2.8285
DFED	0.0067	0.0019	3.5160
$\Delta(l_t - l_t^*)$	0.0121	0.0021	5.6578
$\Delta(l_{t-1} - l_{t-1}^*)$	0.0115	0.0021	5.3888
R^2	0.7423		
Adjusted R^2	0.7140		

Table 5: ECM with stock market indices

Variable	Coefficient	Std. Error	t-Statistic
$\Delta(b_t - b_t^*)$	-0.1564	0.0223	-7.0208
Δv_t	-0.0254	0.0057	-4.4316
ect_{t-1}	-0.4384	0.0634	-3.7615
DECB	-0.0073	0.0024	-3.0436
DFED	0.0074	0.0019	3.9303
R^2	0.693972		
Adjusted R^2	0.640733		